

Relationship of Refinery Operations and Oil-Fired Generation

**Prepared for the
U.S. Department of Energy**

**by the
University of Hawaii**

**Terrence Surles
Hawaii Natural Energy Institute
School of Ocean and Earth Science and Technology**

August 2007

Acknowledgement: This material is based upon work supported by the United States Department of Energy under Award Number DE-FG36-06GO4613.

The University of Hawaii - Hawaii Natural Energy Institute (HNEI) prepared these reports for the U.S. Department of Energy (USDOE), supported by USDOE funding HNEI received through its contract with the State of Hawaii Department of Business, Economic Development, and Tourism.

Disclaimer: This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference here in to any specific commercial product, process, or service by tradename, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

Table of Contents

<u>Section Number and Title</u>	<u>Page Number</u>
Introduction	1
Commentary on Efforts to Obtain Support from “Hawaii-based Refinery Experts”	1
Observations on Possible Impacts	2
Excerpts from Natural Gas Import Options Report	2
LNG Impact: Refinery Response	2
Concluding Remarks (as excerpted)	4
Final Comments for This Report	5

Relationship of Refinery Operations and Oil-Fired Generation

Introduction

This report is one of a series of reports prepared as part of a request of the Secretary of the US Department of Energy to evaluate the economic consequences of Hawaii's dependence on petroleum under a number of scenarios, as prescribed in Section 355 of the Energy Policy Act of 2005. This report will provide a summation of efforts to obtain and evaluate a set of analyses for examining the impact of the three Section 355 scenarios on state-based refinery operations.

The output of this task was supposed to have been an evaluation and analysis of the relationship between oil-fired electricity generation and the in-state production of refined and/or ancillary petroleum products from state-based refineries. Also incorporated into this set of impact analyses was an examination of the enhanced utilization of renewable resources for transportation fuels. As outlined in the original Scope of Work between the Hawaii Natural Energy Institute and the Hawaii Department of Business, Economic Development, and Tourism, it was agreed that "(w)here possible, the CONTRACTOR shall work with Hawaii-based refinery experts."

The following section will provide a commentary of efforts to obtain this expertise and some related comments derived from other parts of this study, as well as other studies that attempt to address the impacts of accelerated renewable resource scenarios and of substantive use of liquefied natural gas (LNG) on state-based refinery operations.

Commentary on Efforts to Obtain Support from "Hawaii-based Refinery Experts"

The primary focus for obtaining this support was through the Hawaii Energy Policy Forum (HEPF), specifically the Hydrocarbons Sub-Committee, later re-named the Energy Security Sub-Committee. The early interactions with the participants were very positive and it appeared that the program would obtain the support it needed from the local experts for obtaining their analyses. Additionally, HNEI was able to engage additional support from the management of the refinery that – at the time of the start of the study – did not have any participants within the Sub-Committee.

Unfortunately, following these initial positive responses, very little support was obtained from the HEPF Sub-Committee. Suffice to say that the participants from this group simply ceased any substantive communication with program management and staff. In the case of the management from the other refinery, they continued to be quite supportive of the study and did perform the analyses needed as part of the program. However, upon completion of those analyses, final approval for release of that document had to await final approval from senior corporate management. At the time of this report preparation, this approval has not been received and no date has been given for possible approval. Given DBEDT's contractual delivery date for final documents, HNEI is required to produce this document. It should be noted in completing this section that program managers and DBEDT management have been apprised of this situation.

Observations on Possible Impacts

There have been a number of studies performed for DBEDT, DOE, and the private sector examining the potential impacts of these types of scenarios on state refinery operations.

On a higher level, Fereidun Fesharaki, of FACTS Global Energy, has performed numerous studies examining potential impacts both globally and locally. His analyses agree with similar comments made in other reports as part of this study. Specifically, the current Energy Information Agency projections for oil prices are probably flawed. This comment is due to the continued growth in oil demand by emerging – and major – economies, such as China and India, and the future concentration of oil reserves in a smaller number of countries. This analysis is coupled with the observation that rapidly increasing oil prices and the related increased pump prices have had no effective impact on demand for petroleum products. Given recent behavior in the state, it should be assumed that there would be no change in transportation fuel needs in the near future.

Thus, it would be difficult to estimate the potential for closure of the local refineries under these scenarios. A recent (August 2003) analysis was performed for DBEDT by Stillwater Associates, entitled “A Policy and Market Analysis of Gasoline Pricing and the Petroleum Industry in Hawaii.” In this report, Stillwater pointed out that we currently lack an integrated model (or sufficiently detailed information from the refineries) to capture the economic effects of industry actions. Thus, Stillwater experts developed rough multipliers to estimate the possible impact of closing the state-based refineries. Based upon current employment figures for the refineries and for the import terminal, it was estimated that, potentially, 1400 jobs would be lost, representing 0.2% of Hawaii’s total workforce. Stillwater experts estimated that this job loss, coupled with other operating expenses, would result in a loss of “net” income to the state of approximately \$150 million per year.

FACTS Global Energy was also retained as part of this study to evaluate the natural gas options for the state of Hawaii. The report, co-funded by the Office of Hawaiian Affairs is entitled “Evaluating Natural Gas Import Options for the State of Hawaii.” In particular, the potential for displacing oil as the resource for electricity was examined utilizing either LNG or compressed natural gas (CNG). This report has previously been submitted to and approved by DBEDT as part of this overall program. However, FACTS analyses provided some commentary on potential impacts to refinery operations should LNG or CNG replace oil at most of the fossil-fired power plants in the state. It is most appropriate at this point to insert the summary of the FACTS analysis from that report in this section. It is the concluding segment in Chapter 11 of that report entitled “LNG and Possible Disruptions to Existing Infrastructure: Implications for Energy Security and the Hawaii Economy.”

(The following two sections are excerpted from the report cited above.)

LNG Impact: Refinery Response

Our analysis in the Hawaii Hydrocarbon Outlook and the report done by Stillwater Associates clearly indicate that the profits of the refineries will suffer if LNG displaces LSFO in power generation. Whether one or both refineries will shutdown depend on a

multitude of variables, such that even the industry players that are intimately involved are not certain what will happen.

If a Hawaii refinery were to shutdown, there are a number of potential drawbacks that should be considered, some of which have more merit than others. First, consider energy security. Importing LNG would serve to diversify Hawaii's energy base, reduce oil use, and could help limit energy price volatility. However, if this leads to the closure of a refinery, the State would have to import larger quantities of refined petroleum products. Although it is true that these products are produced from oil, and thus overall oil use does not change with one or two refineries in operation, the State would require a variety of products, which may not be as widely traded as crude oil. In terms of energy security, diversifying through LNG is likely to be advantageous, but this caveat should be kept in mind.

Whether LNG comes to Hawaii or not in the longer term, both refineries face challenges in terms of changing environmental specifications (sulfur standards continue to tighten everywhere and the refiners have a limited ability to cope with these), scale (the refineries are on the small side), and high operating costs (industrial business in Hawaii is difficult). These challenges remain irrespective of the LNG entering Hawaii.

Looking to the US West Coast or to export refineries in Singapore or Korea, it becomes clear that competition in the Pacific market comes from refineries that are generally at least as large as the two Hawaiian refineries taken together (less than 150 kb/d) and more often larger than 200 kb/d. The scale of refining affects economics dramatically, as the number of personnel does not rise in proportion to increasing capacity; a typical 100 kb/d refinery might have 300-400 direct employees, but a 200 kb/d facility might have the same number.

The Hawaiian refineries employ an estimated 800-900 people, far above the number of employees that would be expected in most situations for a single 150 kb/d refinery. Add to this the fact that Hawaiian wage and benefit costs are comparatively high, include a substantial tax burden and generally higher costs for all inputs, and it is not surprising that Hawaiian refiners face a higher per barrel operating cost than most of their competitors. The refineries would face a better outlook as a single, integrated unit with a consolidated overhead, but even in this case the per barrel costs would remain high.

The one advantage the Hawaiian refiners have is their remoteness; it is cheaper to transport crude oil than refined products (with the exception of fuel oil, which can be moved at prices similar to crude if it is wanted in large volumes). This transport differential gives a slight edge that goes some way toward canceling out the higher per barrel processing costs.

Nonetheless, having the Oahu fuel-oil demand vanish owing to the import of LNG would change the economic landscape of refining in Hawaii. The first immediate effect would probably be a change in the crude slate, shifting away from such a sweet diet to one higher in sulfur. The second immediate effect would probably be a further shift to light crudes (although the present slate is already fairly light). The third immediate effect would probably be a decline in overall crude runs to avoid large exports of fuel oil—though this would depend heavily on market conditions. In the latter case, it is likely that imports of light products would increase.

Thus, several outcomes for the refining industry are possible if the Oahu utility fuels market is eliminated. The industry might retrench and adapt. Modest new investments might be undertaken, possibly over many years, to allow the refiners more flexibility in the crude diet. Or, at the extreme, the industry might be consolidated, expanded, and upgraded to meet the needs of the export market on top of existing local demands.

What needs to be stressed is that any of these outcomes is possible with or without the displacement of Oahu's utility fuel-oil demand. Slashing the demand for LSFO could put new pressure on the refiners (though it also allows them additional room to maneuver), but it is only one of many challenges they face and maintaining the existing market for fuel oil is no guarantee that one or both refiners will continue to operate.

Concluding Remarks (as excerpted)

Hawaii is not by its nature a highly competitive market. Total demand is not large enough to allow many suppliers or duplication of infrastructure. When the Tesoro (then PRI) refinery was first proposed, one of the advantages stressed was that having two refiners would create a more competitive market. How true is this idea? What risks does Hawaii face if one refiner closes, leaving the other as sole operator?

Two refiners do tend to create a more competitive environment than one, but the pressures are not as great as one might imagine. In a closed market, two, three, or even a half-dozen oil companies can learn to live and manage with each other. It is exposure to the external market and the trade connections with other sources of supply that creates a competitive situation. Therefore, while the establishment of a second refinery undoubtedly helped the competitive environment, imports, the threat of imports, and price formulas linked to markets elsewhere have had a major impact. As discussed earlier in this chapter, imports always act as a constant check on the price of fuels produced in Hawaii. LSFO is pegged to a formula that represents what delivery costs would be and other utility fuels are also tied to prices outside the Hawaiian market. The situation in gasoline and diesel is obviously less competitive, but the establishment of an independent import terminal on Oahu helps bring the pressure of import prices to bear on the local market for those fuels as well.

To summarize: the closure of one or both refineries is neither inevitable nor does it necessarily lower the competitiveness of the market in Hawaii, indeed, if steps are taken to ensure that a wider selection of fuel suppliers have access to the market (especially in terms of import infrastructure), then price competition might actually be strengthened. It should be noted, however, that this might not happen through purely market forces, the State might have to take a role in ensuring wider access to terminals and tankage.

Enhanced competition, however, may not be an unmitigated boon. Issues of liability for pollution events and other problems need to be considered carefully. Logistical and technical problems may also become more difficult to solve if the suppliers do not have major investment stakes in the Hawaiian economy—and this problem may be more acute in the case of suppliers owned by corporations with limited real assets. None of these difficulties are insurmountable, but if refinery closures seem imminent, the State of Hawaii needs to study policy options to deal with potential problems before they occur.

(Conclusion of Excerpted Material)

Final Comments for This Report

It is clear that there will be impacts associated with any acceleration of renewable resource use or from incorporation of natural gas on the state-based refineries. However, as noted in the preceding sections, these possible impacts are not well understood by anyone at the moment. To properly assess the potential impacts of these scenarios on the local refineries will require additional work from outside consultants.

Given the thrust of the Secretary of Energy request, a lack of thorough analysis on refinery operations and economics, coupled to the concomitant impacts on the state's economy, will lead to a flawed report. What is pointed out in other reports in this 355 series is the fact that, not only do the refineries provide jobs and contracts for supporting industry, but other products from the refineries, such as jet fuel, gasoline, and asphalt, are important products for enhancing the state's economy. Thus, a final conclusion for this brief white paper report is that additional funding should be supplied in order to have experts such as FACTS Global Energy, Stillwater Associates or some similarly well-qualified organization do an additional and thorough analysis of the potential impacts to the state economy due to the possible realization of any of the three 355-prescribed scenarios.